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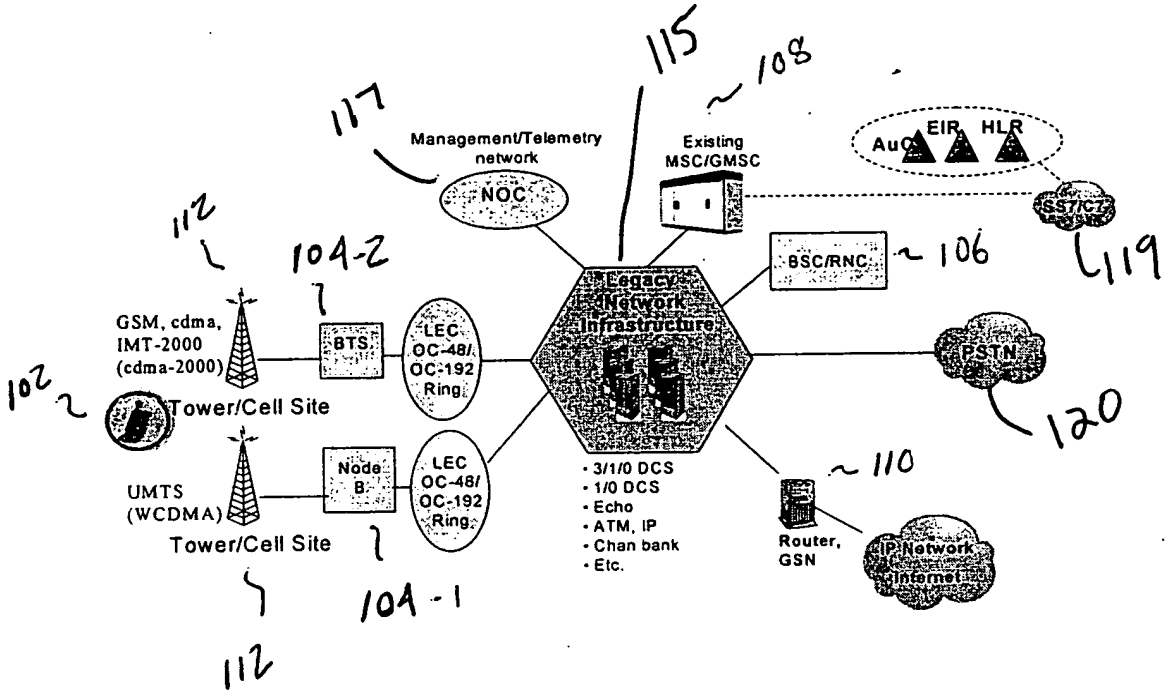

115
108
117
Management/Telemetry network
NOC
Existing MSC/GMSC
AuC
EIR
HLR
SS7/C7
119
112
104-2
BSC/RNC
106
GSM, cdma, IMT-2000 (cdma-2000)
BTS
LEC OC-48/ OC-192 Ring
Legacy Network Infrastructure
PSTN
120
102
Tower/Cell Site
UMTS (WCDMA)
Node B
LEC OC-48/ OC-192 Ring
• 3/1/0 DCS
• 1/0 DCS
• Echo
• ATM, IP
• Chan bank
• Etc.
110
Router, GSN
IP Network Internet
Tower/Cell Site
104-1
112

FIG. 1

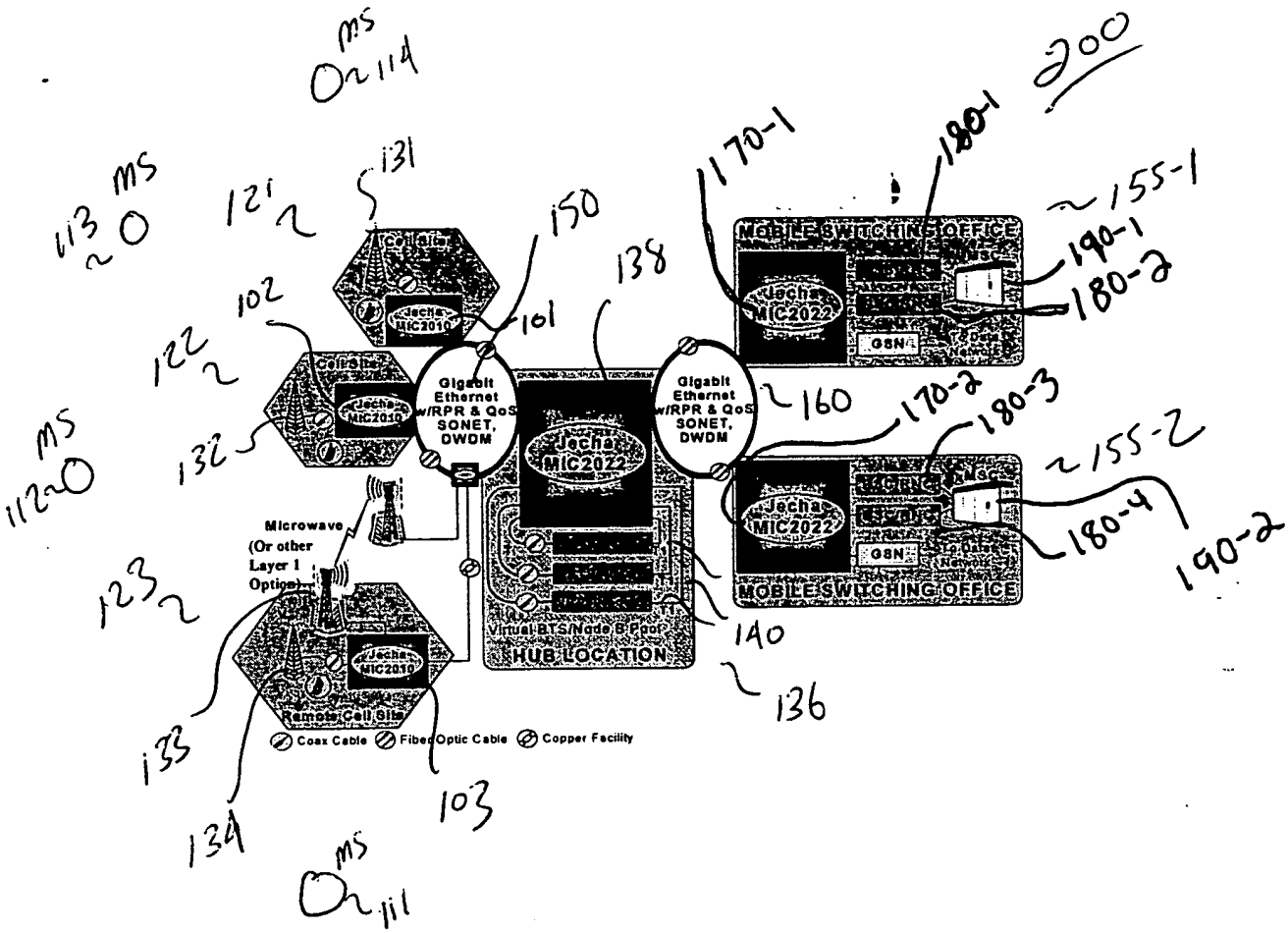

MS 114
200
MS 113
120
121
131
150
170-1
180-1
155-1
MOBILE SWITCHING OFFICE
190-1
180-2
102
101
138
122
120
Gigabit Ethernet w/RPR & QoS SONET, DWDM
160
MS 112
120
132
170-2
180-3
155-2
180-4
190-2
Microwave (Or other Layer 1 Optical)
123
140
Virtual BTS/Node B Pool
HUB LOCATION
136
133
Remote Cell Site
Coax Cable
Fiber Optic Cable
Copper Facility
134
103
MS 111

FIG. 2

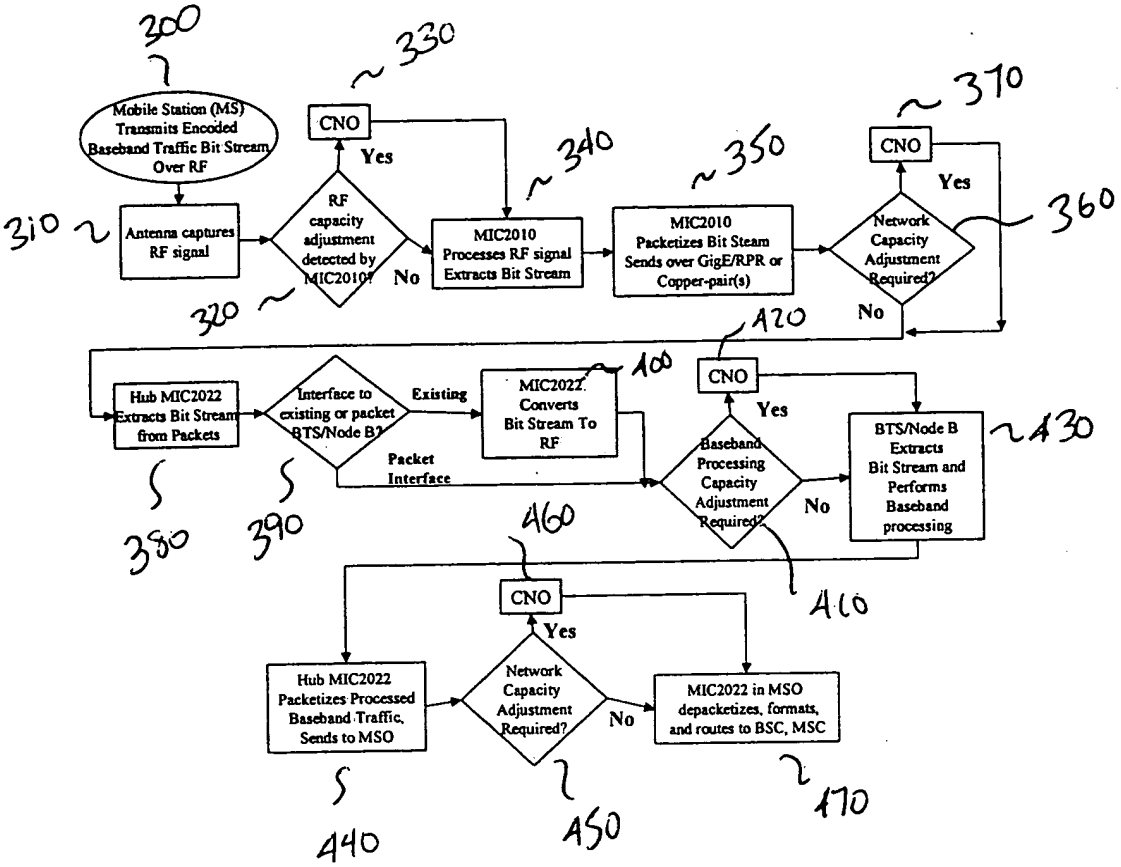

300
Mobile Station (MS) Transmits Encoded Baseband Traffic Bit Stream Over RF
310
Antenna captures RF signal
320
RF capacity adjustment detected by MIC2010?
CNO
Yes
No
330
340
MIC2010 Processes RF signal Extracts Bit Stream
350
MIC2010 Packetizes Bit Steam Sends over GigE/RPR or Copper-pair(s)
370
CNO
Yes
Network Capacity Adjustment Required?
360
No
380
Hub MIC2022 Extracts Bit Stream from Packets
390
Interface to existing or packet BTS/Node B?
Existing
Packet Interface
100
MIC2022 Converts Bit Stream To RF
420
CNO
Yes
Baseband Processing Capacity Adjustment Required?
No
430
BTS/Node B Extracts Bit Stream and Performs Baseband processing
410
460
CNO
Yes
Hub MIC2022 Packetizes Processed Baseband Traffic, Sends to MSO
440
Network Capacity Adjustment Required?
450
No
MIC2022 in MSO depacketizes, formats, and routes to BSC, MSC
470

FIG. 3

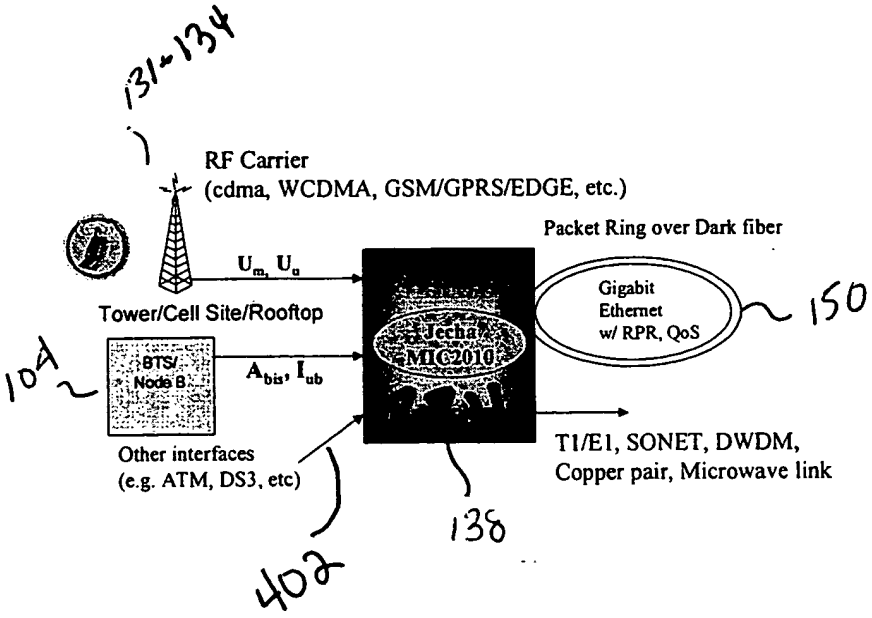

131-134
RF Carrier
(cdma, WCDMA, GSM/GPRS/EDGE, etc.)
Packet Ring over Dark fiber
U_m, U_a
Tower/Cell Site/Rooftop
Gigabit
Ethernet
w/ RPR, QoS
150
Jecha
MIG2010
104
BTS/
Node B
A_{bis}, I_{ub}
T1/E1, SONET, DWDM,
Copper pair, Microwave link
Other interfaces
(e.g. ATM, DS3, etc)
138
402

FIG. 1

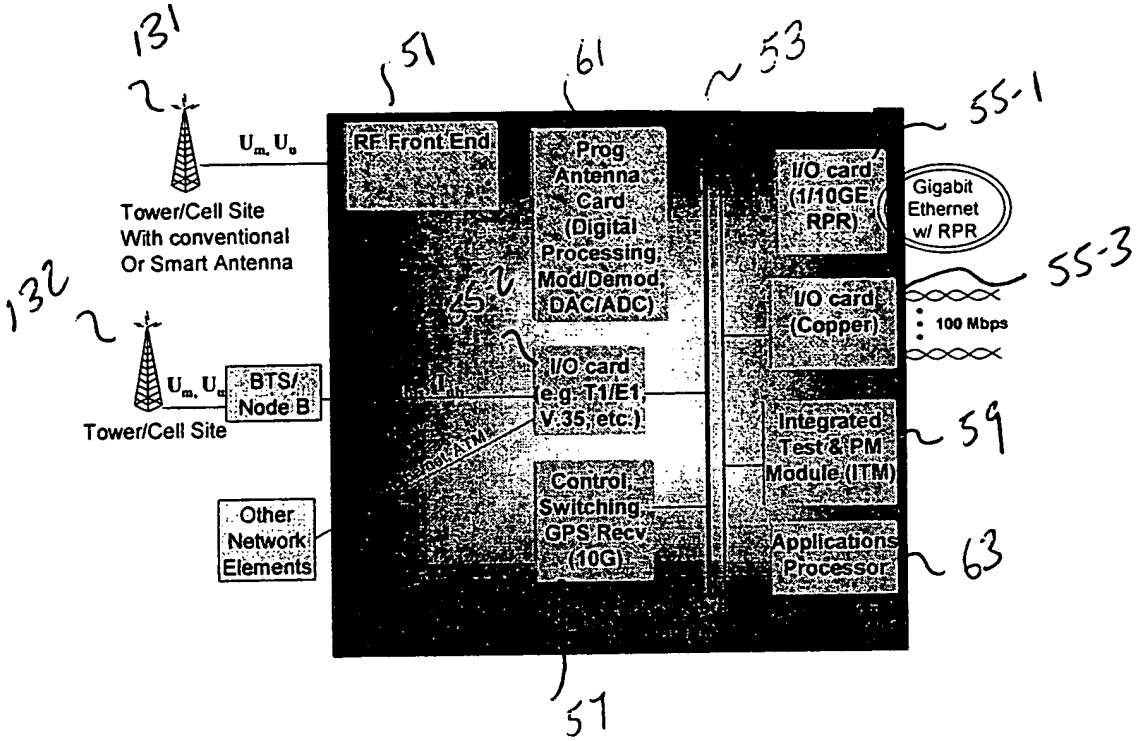
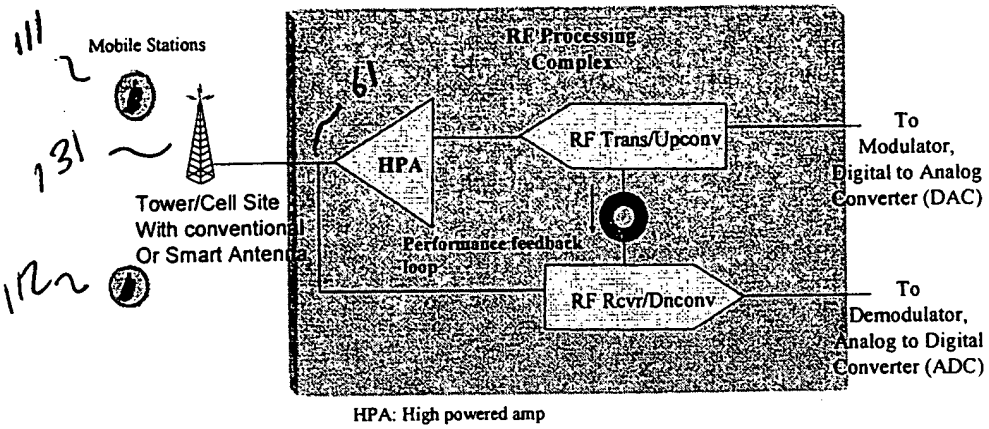

101-103
131
51
61
53
55-1
55-3
59
63
57
Tower/Cell Site
With conventional
Or Smart Antenna
132
Tower/Cell Site
BTS/
Node B
Other
Network
Elements
RF Front End
Prog
Antenna
Card
(Digital
Processing,
Mod/Demod,
DAC/ADC)
I/O card
(e.g. T1/E1,
V.35 etc.)
Control,
Switching,
GPS Recv
(10G)
I/O card
(1/10GE
RPR)
Gigabit
Ethernet
w/ RPR
I/O card
(Copper)
100 Mbps
Integrated
Test & PM
Module (ITM)
Applications
Processor

FIG. 5



HPA: High powered amp

Fig. 6

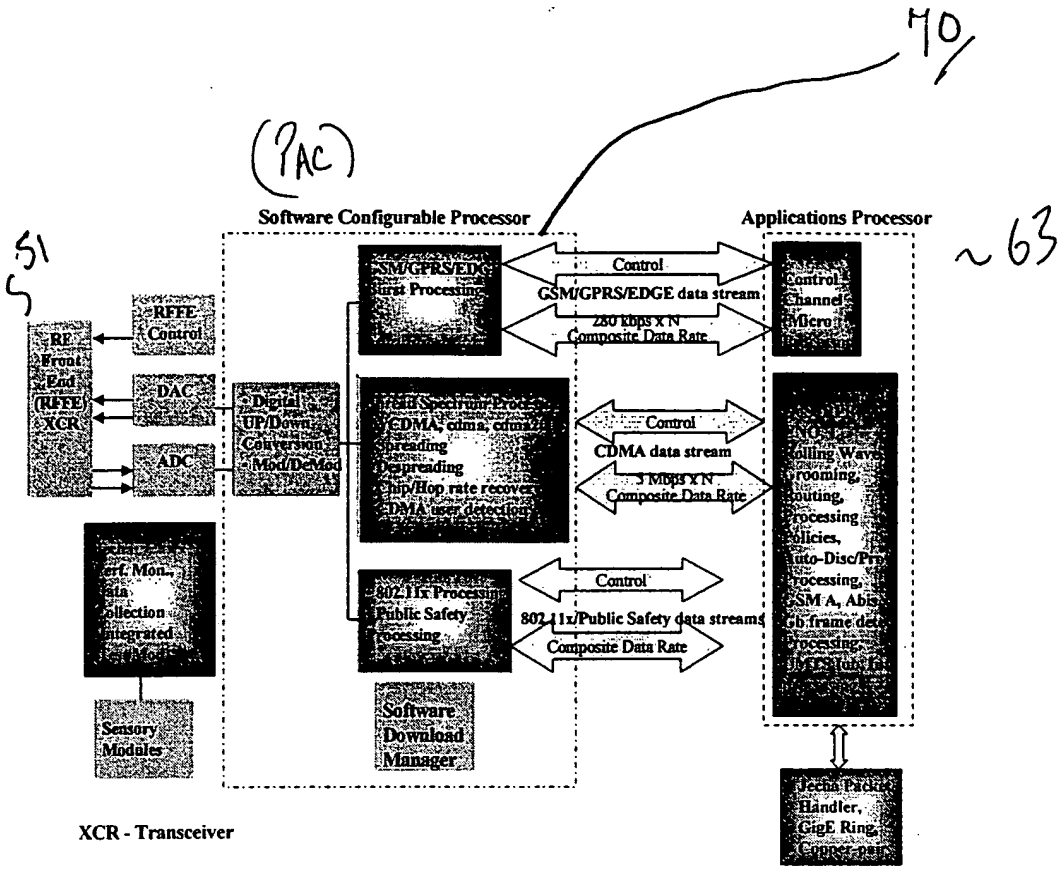

70
(PAC)
Software Configurable Processor
Applications Processor
63
51
RFFE Control
RF Front End (RFFE) XCR
DAC
ADC
Digital UP/Down Conversion Mod/DeMod
Control
GSM/GPRS/EDGE data stream
280 kbps x N Composite Data Rate
Control
CDMA data stream
3 Mbps x N Composite Data Rate
Control
802.11x/Public Safety data streams
Composite Data Rate
Sensory Modules
Software Download Manager
XCR - Transceiver

FIG. 7

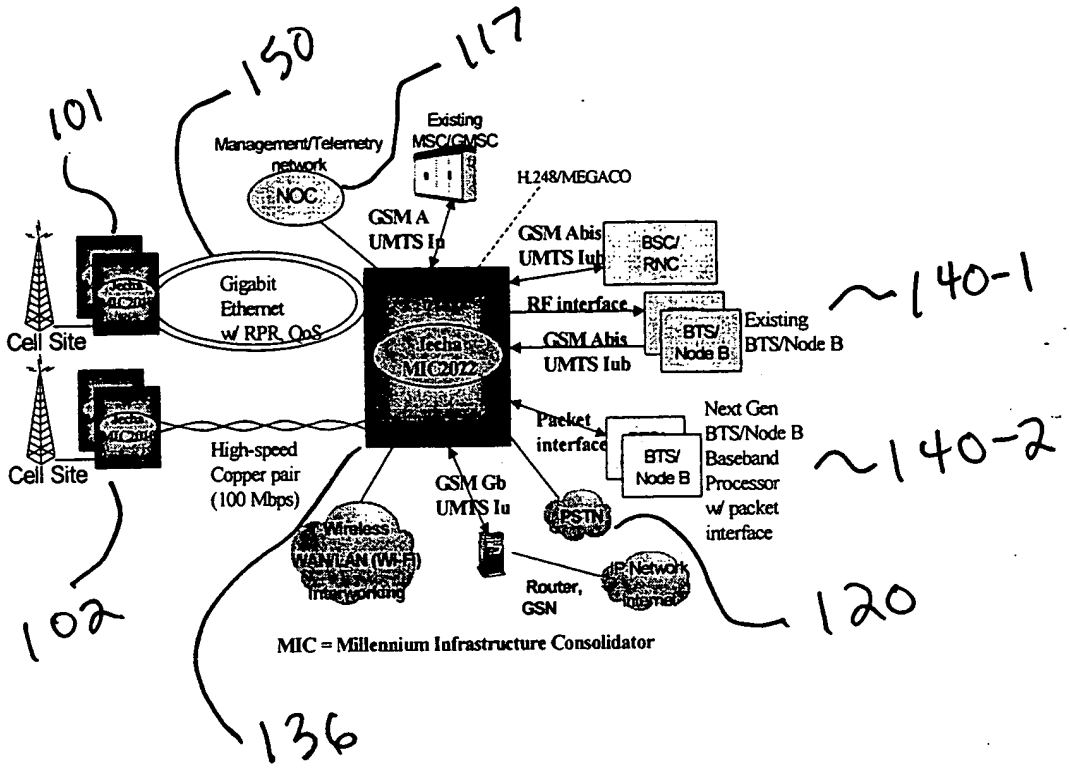

101
150
117
Management/Telemetry network
NOC
Existing MSC/GMSC
H.248/MEGACO
GSM A
UMTS Iu
GSM Abis
UMTS Iub
BSC/ RNC
Gigabit Ethernet w/ RPR QoS
RF interface
GSM Abis
UMTS Iub
BTS/ Node B
Existing BTS/Node B
140-1
Cell Site
Cell Site
High-speed Copper pair (100 Mbps)
Packet interface
BTS/ Node B
Next Gen BTS/Node B Baseband Processor w/ packet interface
140-2
GSM Gb
UMTS Iu
PSTN
Wireless WAN/LAN (Wi-Fi)
Router, GSN
IP Network
120
102
136
MIC = Millennium Infrastructure Consolidator

FIG. 8

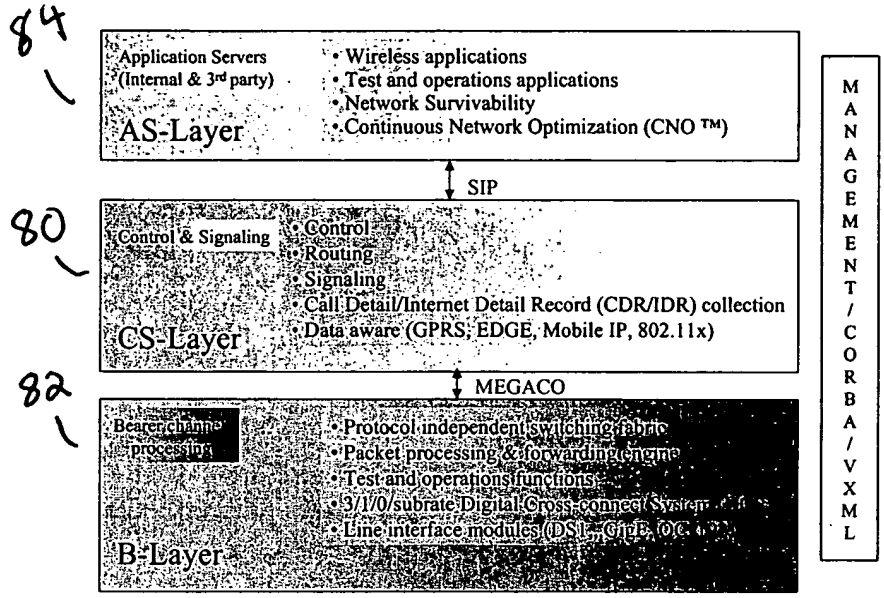

84
Application Servers
(Internal & 3rd party)
AS-Layer
• Wireless applications
• Test and operations applications
• Network Survivability
• Continuous Network Optimization (CNO ™)
SIP
80
Control & Signaling
CS-Layer
• Control
• Routing
• Signaling
• Call Detail/Internet Detail Record (CDR/IDR) collection
• Data aware (GPRS, EDGE, Mobile IP, 802.11x)
MEGACO
82
Bearer channel processing
B-Layer
• Protocol independent switching fabric
• Packet processing & forwarding engine
• Test and operations functions
• 3/1/0/subrate Digital Cross-connect System
• Line interface modules (DS1 – GigE, OC-x)
MANAGEMENT/CORBA/VXML

FIG. 9

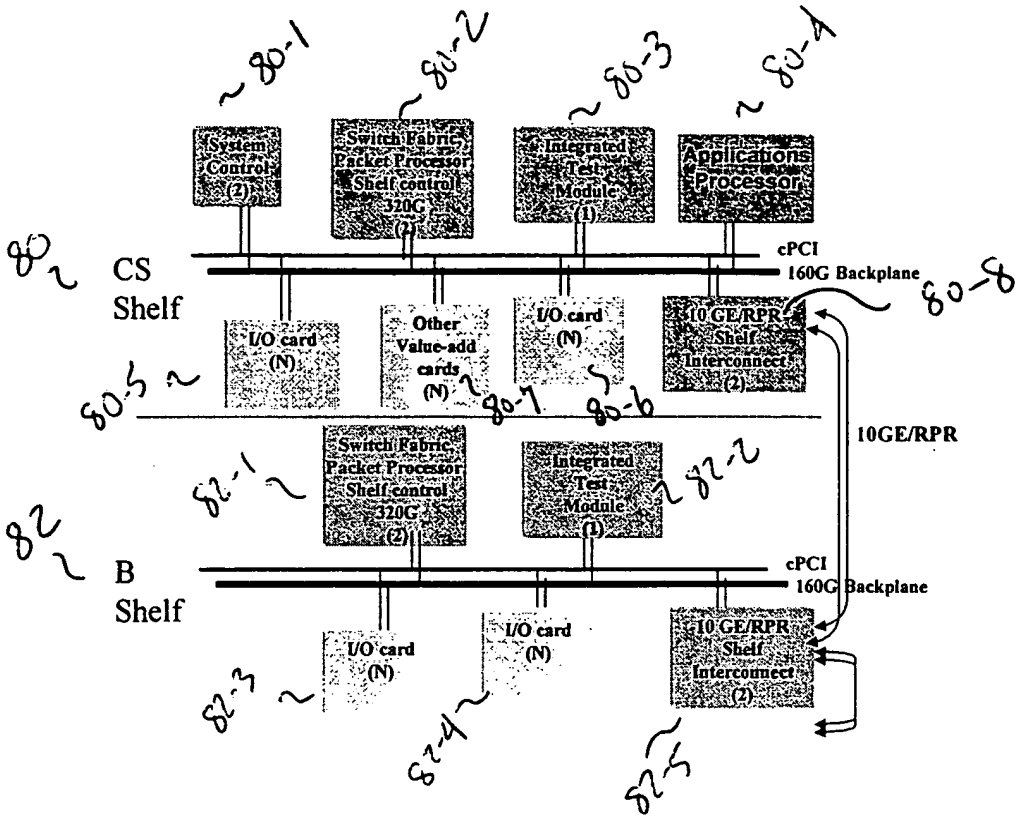

80-1
80-2
80-3
80-4
System Control (2)
Switch Fabric Packet Processor Shelf control 320G (2)
Integrated Test Module (1)
Applications Processor
80
CS Shelf
cPCI
160G Backplane
80-8
I/O card (N)
Other Value-add cards (N)
I/O card (N)
10 GE/RPR Shelf Interconnect (2)
80-5
80-7
80-6
10GE/RPR
82-1
Switch Fabric Packet Processor Shelf control 320G (2)
Integrated Test Module (1)
82-2
82
B Shelf
cPCI
160G Backplane
I/O card (N)
I/O card (N)
10 GE/RPR Shelf Interconnect (2)
82-3
82-4
82-5

FIG. 10

1100

High-Level Architecture
Millennium Management System

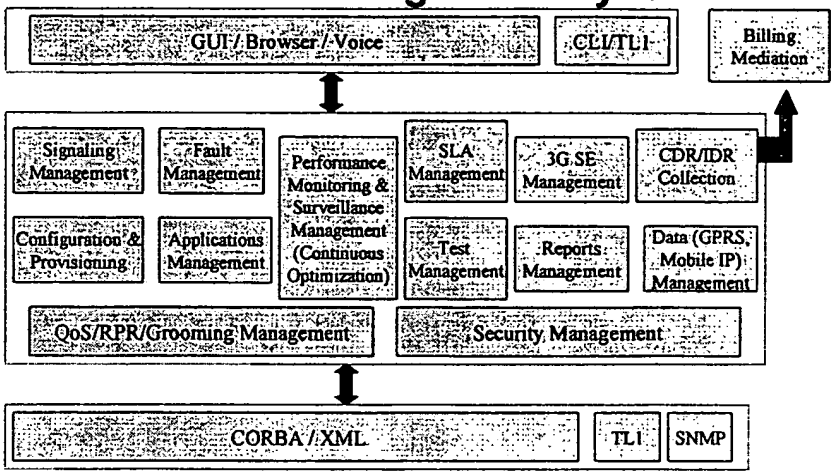


FIG. 11

1200

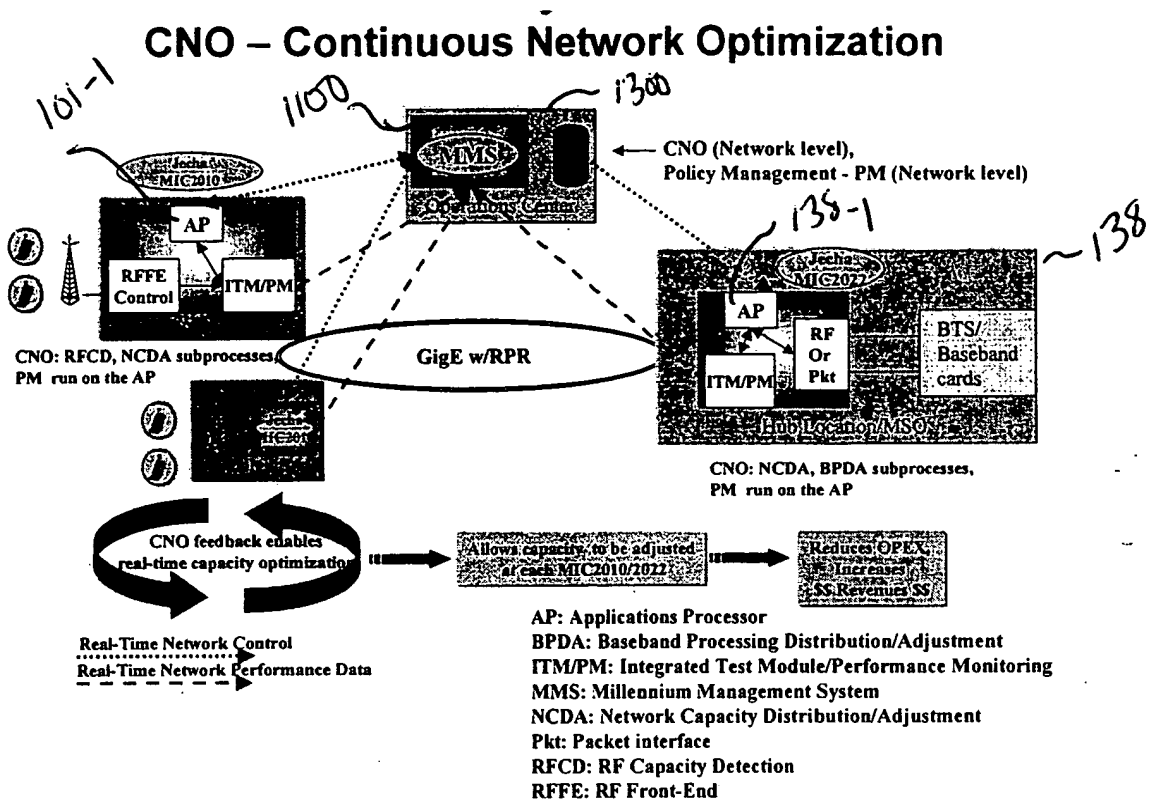

CNO – Continuous Network Optimization
101-1
1100
1300
MMS
Operations Center
CNO (Network level),
Policy Management - PM (Network level)
Jecha MIC2010
AP
RFFE Control
ITM/PM
CNO: RFCD, NCDA subprocesses,
PM run on the AP
GigE w/RPR
135-1
138
Jecha MIC2077
AP
RF Or Pkt
ITM/PM
BTS/ Baseband cards
Hub Location/MSO
CNO: NCDA, BPDA subprocesses,
PM run on the AP
CNO feedback enables real-time capacity optimization
Allows capacity to be adjusted at each MIC2010/2022
Reduces OPEX
Increases $$ Revenues $$
Real-Time Network Control
Real-Time Network Performance Data
AP: Applications Processor
BPDA: Baseband Processing Distribution/Adjustment
ITM/PM: Integrated Test Module/Performance Monitoring
MMS: Millennium Management System
NCDA: Network Capacity Distribution/Adjustment
Pkt: Packet interface
RFCD: RF Capacity Detection
RFFE: RF Front-End

FIG. 12

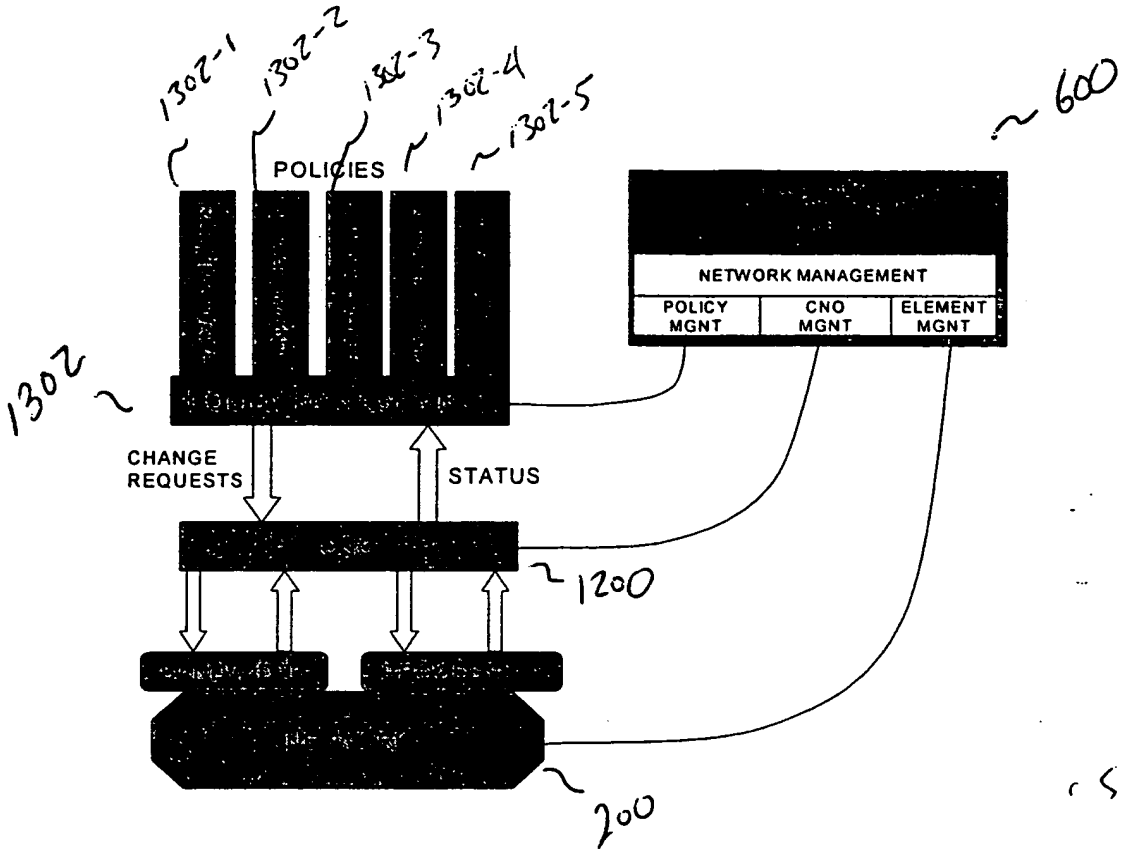

1302-1
1302-2
1302-3
1302-4
1302-5
POLICIES
600
NETWORK MANAGEMENT
POLICY MGNT
CNO MGNT
ELEMENT MGNT
1302
CHANGE REQUESTS
STATUS
1200
200

FIG. 13

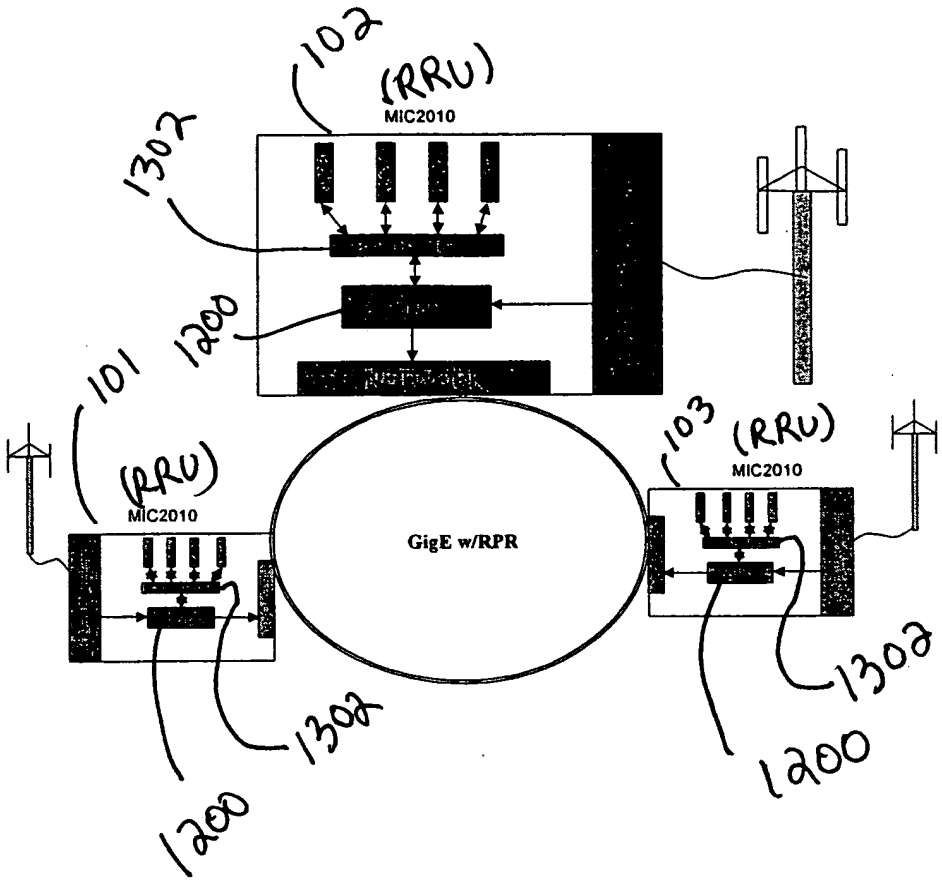

102
(RRU)
MIC2010
1302
1200
101
(RRU)
MIC2010
GigE w/RPR
103
(RRU)
MIC2010
1302
1200
1200
1302

FIG. 1A

Transit / Transmit Buffer Arch

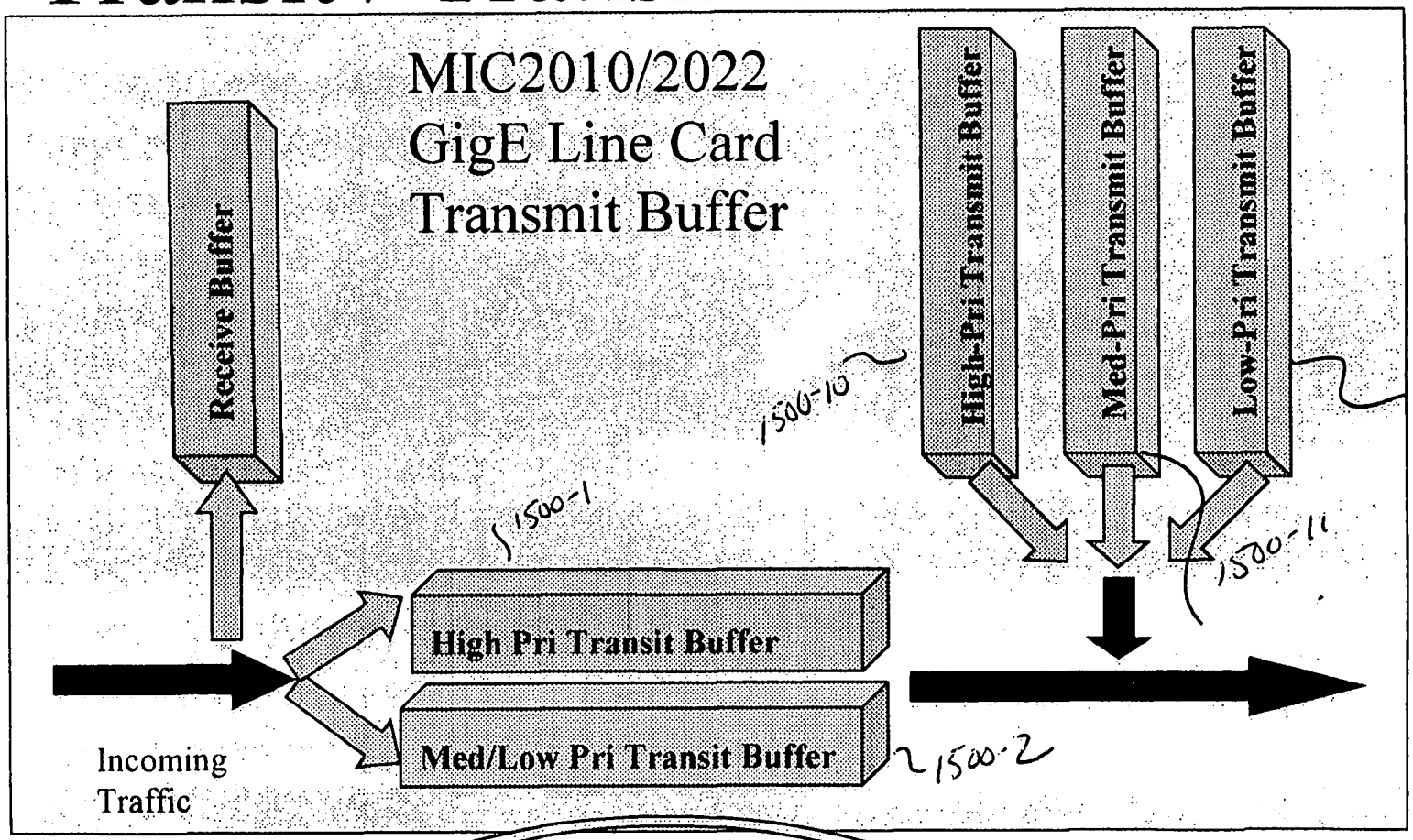


FIG. 15

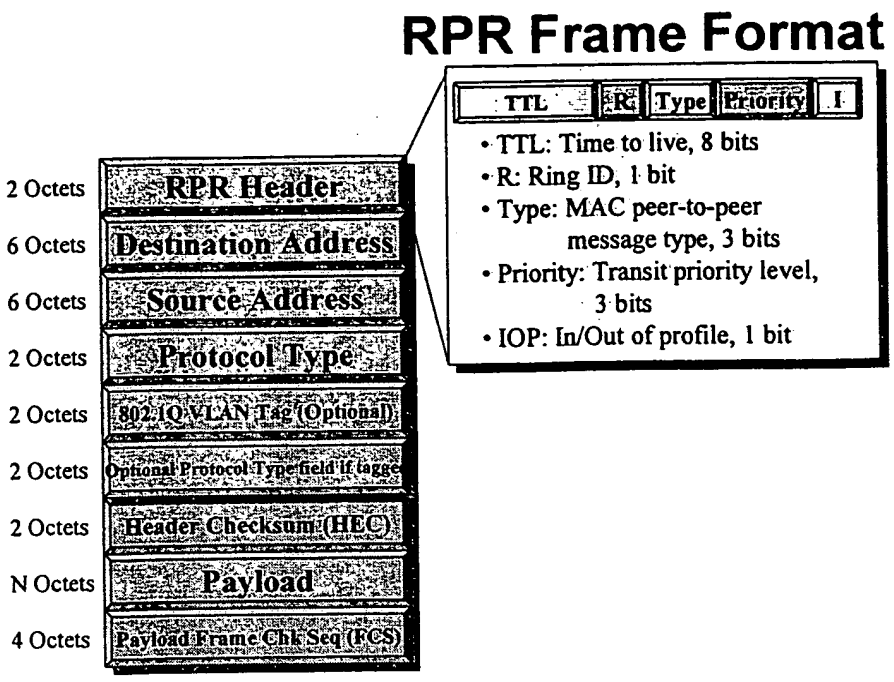

RPR Frame Format
TTL
R
Type
Priority
I
• TTL: Time to live, 8 bits
• R: Ring ID, 1 bit
• Type: MAC peer-to-peer message type, 3 bits
• Priority: Transit priority level, 3 bits
• IOP: In/Out of profile, 1 bit
2 Octets
RPR Header
6 Octets
Destination Address
6 Octets
Source Address
2 Octets
Protocol Type
2 Octets
802.1Q VLAN Tag (Optional)
2 Octets
Optional Protocol Type field if tagge
2 Octets
Header Checksum (HEC)
N Octets
Payload
4 Octets
Payload Frame Chk Seq (FCS)

FIG. 16

Grooming/Alternate Routing

- Grooming by RF carrier or technology (e.g. cdma2000)
- Grooming by Service Provider

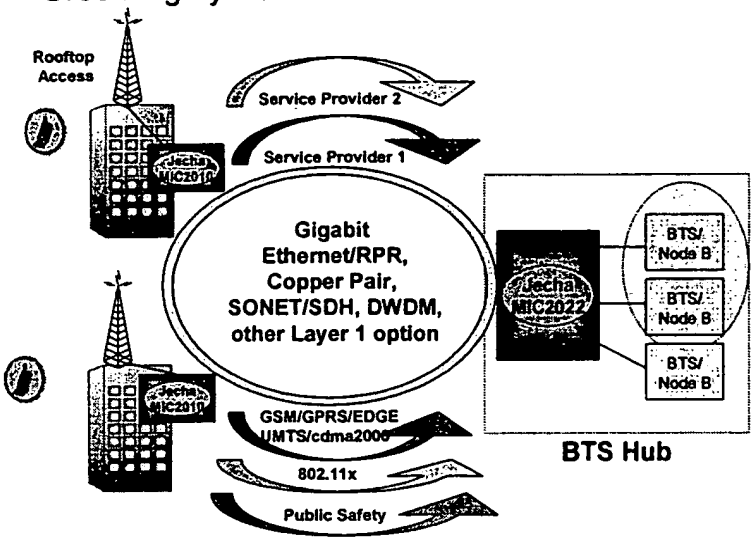


Fig 17

Straight Talk Service, Priority Access Service

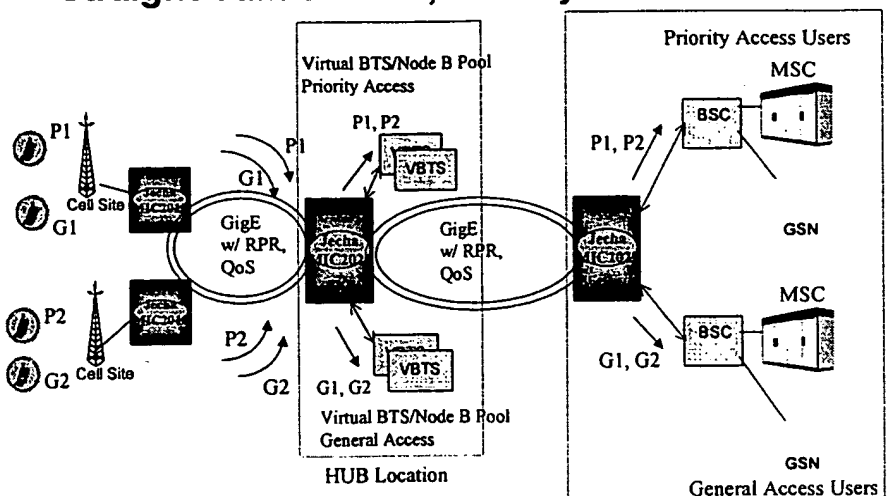


FIG. 18